Demonstration of Multi-Pollutant Capture Including CO_2 and SO_2 from Coal Combustion

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Demonstration Project Team

Organization	Roles
Ohio State University	Project Lead, Testing, Data Analysis
Clear Skies Consulting	Project Manager
AEP	Co-funder
AirPol, Inc.	Co-funder
Babcock & Wilcox	Co-funder
CONSOL Energy	Co-funder
Duke Energy	Co-funder
Specialty Minerals Inc.	Co-funder

Solid Sorbent Chemistry

Use of metal oxide (CaO) in a capture and regeneration system

Carbonation: $CaO + CO_2 \rightarrow CaCO_3$ ΔH=-178 kJ/mol

Calcination: $CaCO_3 \rightarrow CaO + CO_2$ ΔH=+178 kJ/mol

Advantages of Carbonation Calcination Reaction (CCR)

- Operates under flue gas conditions
- High equilibrium sorbent capacities
- High CO_2 removals at low Ca/C mole ratios
- Low cost of sorbent
- Regenerative cycle produces pure CO_2 stream

CCR Development Timeline

Timeline	Achievements/Targets
2000-2004	Inception of the concept and detailed lab scale testing at OSU. Funded for 4 years by the OCDO.
2005-2009	Integration of various unit operations and testing in a continuous system at a research test facility built at OSU
2009-2011	Pilot scale demonstration or testing in a slip stream of a Pulverized Coal Boiler facility
2011-2015	Full Scale Demonstration and Commercialization of this technology

Sub-Pilot Demonstration Process

Summary of Phase I Results

- Demonstrated continuous operation for over 13 hours
- Demonstrated >90% CO_2 and 100% SO_2 Removal
- Determined the effect of residence time, sorbent type, and fly ash addition on CO_2 and SO_2 removal

Sub-Pilot Demonstration Process

Economics

- Parasitic Energy Consumption: Energy required to operate CO_2 capture technology that would otherwise be available for power generation

Amine Scrubbing	30%[1]
Oxycombustion	28%[1]
CCR Process	18-23%

- In terms of cost/ton CO_2 avoided:

Amine Scrubbing	$53[2]
Oxycombustion	$35[2]
PFBC CO_2 Capture	$25[3]